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None

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F2E
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(54) Friction-facings, incorporating wear sensors

(57) A friction-facing e.g. a disc brake pad, which is abradable and contains electrically conductive material, incorporates a wear sensor (10) comprising a pair of terminals (18, 20), for connection to an electrical detection circuit, and wear probes (30, 32) respectively connected to each terminal. The wear probes are embedded within an abradable, electrically insulating compound (34), and are positioned to be contacted at a given wear point (d) by a counterface against which the friction-facing is applied. The insulating compound is capable of trapping electrically conductive material, abraded from the interface between the friction-facing and the counterface, to establish on the sensor an electrically conductive layer which, at the given wear point, will form a conductive link bridging the wear probes.

FIG.1

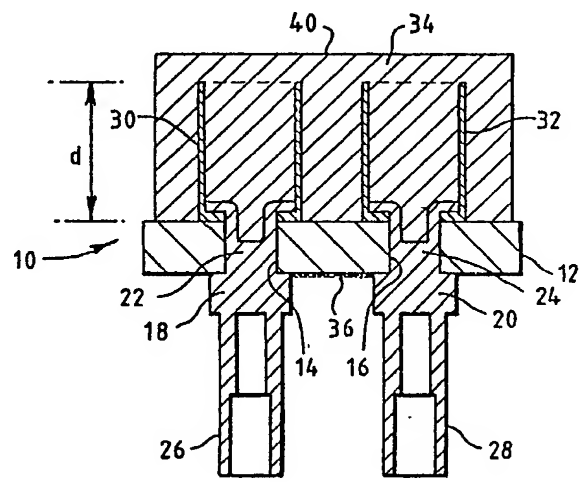

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FIG.1

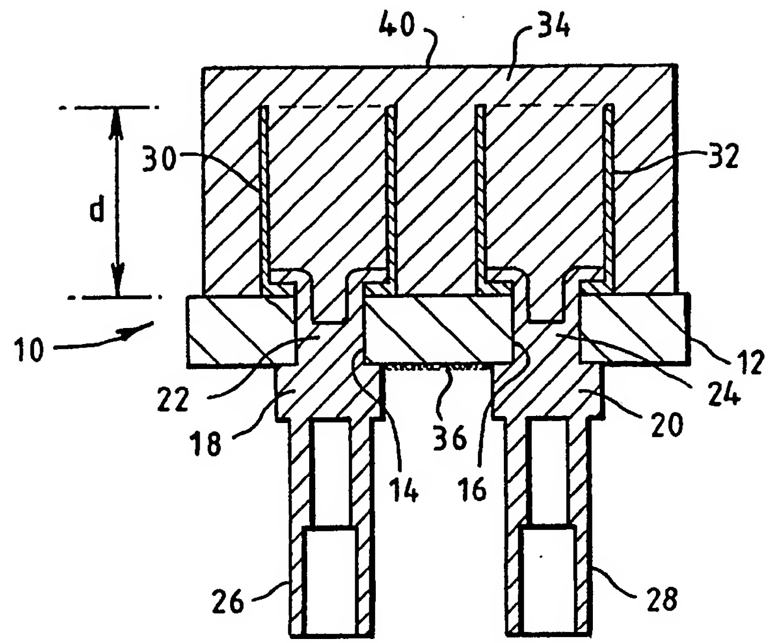


FIG.2

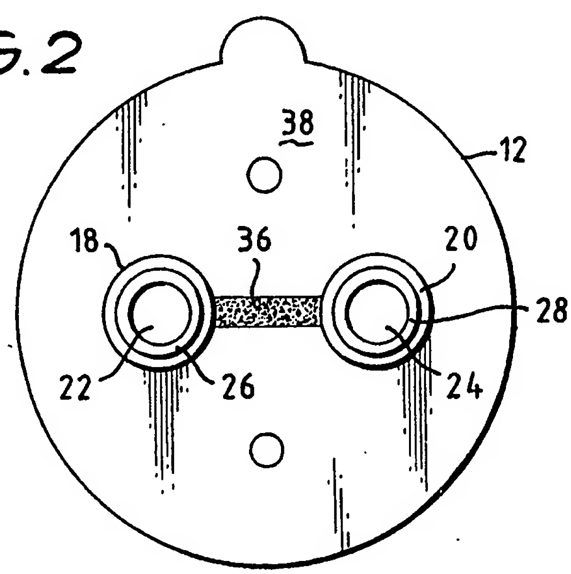


FIG. 4

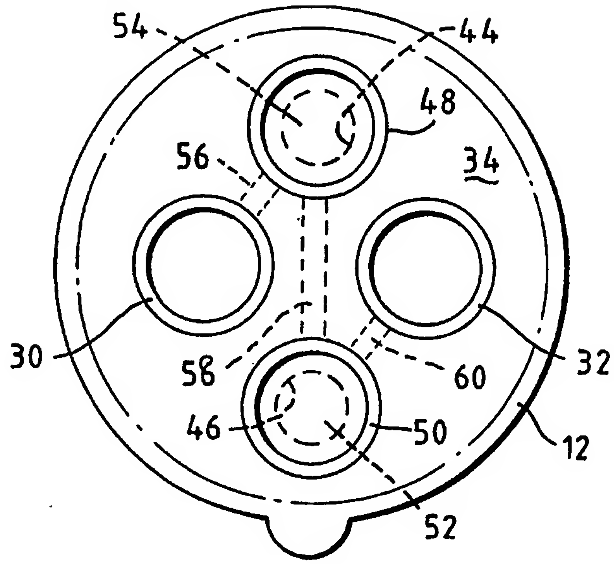
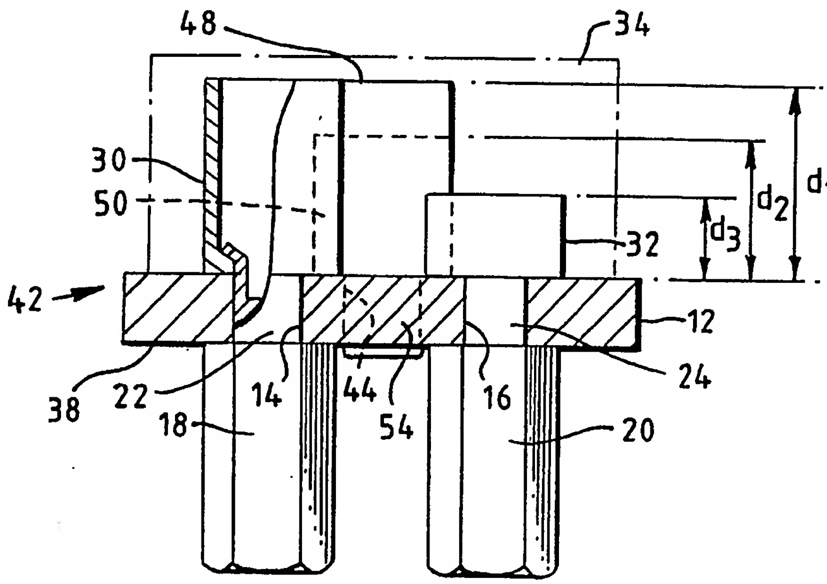

54
44
48
56
34
30
32
58
60
46
50
12
52

FIG. 3


48
34
30
50
32
d_1
d_2
d_3
42
12
38
22
14
44
54
16
24
18
20

SPECIFICATION

Friction-facings incorporating wear sensors

This invention relates to a friction-facing component, such as that forming part of a traction brake; and particularly relates to a friction-facing component incorporating a wear-sensor.

In a known friction-facing component incorporating a wear sensor, specifically a disk brake pad having a wear sensor embedded therein, the sensor has one or more terminals, for connection to an electrical indicator circuit, and a separate wear probe for and connected to the or each terminal; the wear probe or probes being positioned to be contacted at a given wear point by an electrically conducting, counterface against which the friction-facing is applied; the counterface completing the indicator circuit at the given wear point either by forming part of the indicator circuit when a single wear probe is employed or by bridging two wear probes.

Assemblies incorporating such friction-facings have two major disadvantages, the indicator circuit is only completed for as long as the counterface is applied to the friction-facing and the counterface has to be electrically conductive. This means that a wear signal is only produced as and when the brake is applied and, for example, a metal brake disc would be needed.

It is an object of the present invention to provide a friction-facing component incorporating a wear sensor that overcomes the above-stated disadvantages.

According to the present invention, in a friction-facing component incorporating a wear sensor, such as for a traction brake, the friction-facing is abradable and contains electrically conductive material, the wear sensor is located in the friction-facing and comprises a pair of terminals, for connection to an electrical detection circuit, and wear probes; the wear probes being:-

respectively connected to each terminal,

embedded within an abradable, electrically insulating compound, and

positioned to be contacted at a given wear point by a counterface against which the friction-facing is applied;

the insulating compound being capable of trapping electrically conductive material, abraded from the interface between the friction-facing and the counterface, to establish on the sensor an electrically conductive surface layer which, at the given wear point, will form a conductive link bridging the wear probes.

Clearly, with an assembly of a friction-facing component incorporating a wear sensor in accordance with the invention and when worn to the wear point, the indicator circuit will continue to produce a wear signal after the brake has been released. Also, non-metallic counterfaces can be used, such as carbon-fibre brake discs.

In an embodiment of the invention, resistor means are connected between the terminals to provide an indication of circuit continuity; as described in our European Patent Application No. 84307898.1.

In a further embodiment of the invention, one or more additional wear probes of differing height are provided, each positioned to be successively contacted at lower wear points, one of the original wear probes being connected to one of the terminals, an additional wear probe being connected to the other terminal; resistor means being respectively connected between the probes in order probe height and in series between the terminals.

The above and other features of the present invention are described, by way of example, in the Drawings, wherein:-

Figure 1 is a sectional elevation of a single wear point sensor for incorporation in a friction-facing in accordance with a first embodiment of the invention;

Figure 2 is an underplan of the sensor of Figure 1;

Figure 3 is a sectional elevation of a multiple wear point sensor in accordance with a second embodiment of the invention; and

Figure 4 is a plan of the sensor of Figure 3.

As shown by Figures 1 and 2, a single wear point sensor 10 comprises a circular base 12 of electrically insulating ceramic or high temperature plastics material having a pair of diametrically opposite, axial holes 14 and 16. A pair of terminals 18 and 20 have reduced diameter upper stems 22 and 24 located in the holes 14 and 16 respectively; the lower parts of the terminals being formed, in this example, as cable crimps 26 and 28. Clearly these latter terminal parts can be formed to any convenient shape of connector.

The tops of the terminal stems 22 and 24 each pass through a hole in the bottom of a cup-shaped wear probe 30 and 32 respectively; the stem tops being deformed to rivet the wear cups to the base. The open lips of the cup are at a set height d above the base to set the wear point for the sensor. The cups are formed of a soft, easily worn metal such as brass.

The wear cups and the top of the base are embedded in a protective cylinder 34 of an electrically insulating, abradable compound or cement.

A resistor 36 is formed by screen printing a resistive ink onto the under surface 38 of the base 12 so that it will contact the terminals 18 and 20.

In use, the sensor 10 will be inserted into a friction-facing (not shown) so that the wear cups' lips are at the requisite depth and the terminals are connected to an indicator circuit (also not shown); in an example the friction-facing is a sintered metal pad for a disc brake. As the brake is used the upper surface 40 of the protective cylinder picks up a conductive film formed of metal particles abraded from the interface between the disc and the pad. When the pad (and protective cylinder) have worn to the wear point, the conductive film that has been established meets the wear cups' lips and makes an electrical circuit between them; shorting out resistor 36.

The mechanism by which the conductive film or layer is established on the upper surface of the

wear sensor is not presently understood.

However, we have established that using a wear sensor in accordance with the invention inserted into a sintered metal brake pad the following compounds have been found to establish a conductive surface layer:-

1) Commercial cement - FORTAFIX (Trade Mark) LQS6;

2) Commercial cement - FORTAFIX Chromix;

3) A cement made from alumina bonded with aluminium phosphate and chromium trioxide.

We have also found that the following compound does not establish a conductive surface layer:-

4) A cement made from talc/Triton (Trade Mark) fibres bonded with sodium silicate.

The sensor 42 shown by Figures 3 and 4 is a multiple wear point sensor and like parts to the single wear point sensor of Figures 1 and 2 have been given like references. It comprises a circular base 12 of electrically insulating ceramic material having four axial holes 14, 16, 44 and 46 in quadrature. A pair of terminals 18 and 20 have reduced diameter upper stems 22 and 24 located in the holes 14 and 16 respectively; the lower parts of the terminals being formed in this example as snap-in connectors.

The tops of the terminal stems each pass through a hole in the bottom of a cup-shaped wear probe 30 and 32 respectively; the stem tops being deformed to rivet the wear cups to the base. Two further wear probe cups 48 and 50 have reduced diameter lower stems 52 and 54 respectively located in axial holes 44 and 46; the stem bottoms being deformed to rivet these wear cups to the base. The open lips of cups 30 and 48 are at a first height d_1 above the base, the open lip of cup 50 is at a second, lower height d_2 above the base and the open lip of cup 32 is at a third, lowest height d_3 above the base. By this means three wear points can be determined by the sensor. The first d_1 being detected by cups 30 and 48; the second d_2, when cups 30 and 48 wear down to the height of cup 50 and is detected between either of cups 30 and 48 and cup 50; and the third d_3, when cups 30, 48 and 50 have worn down to the level of cup 32 and is detected between any of cups 30, 48 and 50 and cup 32. The cups are again formed of a soft, easily worn metal such as brass.

The wear cups and the top of the base are embedded in a protective cylinder 34 of an electrically insulating, abradable compound or cement.

Resistors 56, 58 and 60 are formed by screen printing a resistive ink onto the undersurface 38 of the base 12, so that resistor 56 connects terminal 18 to cup stem 54, resistor 58 serially connects cup stem 54 to cup stem 52 and resistor 60 serially connects cup stem 52 to terminal 20.

In use, the unworn sensor will have an initial resistance equal to $R_{56} + R_{58} + R_{60}$; when worn to the first wear point d_1, resistor 56 will be shorted out and the resistance will drop to $R_{58} + R_{60}$; when worn to the second wear point d_2, resistor 58 will be shorted out and the resistance will drop to R_{60}; and when worn to the third wear point d_3, resistor 60 will be shorted out and the sensor resistance will be reduced to effectively zero.

For the sensor to work, the conductive layer formed on the upper surface of the cylinder can only have a detectable effect at the wear point if its resistance is no greater than a given value. It is thought that most of the conductive material forming the layer comes from the friction-facing and it seems clear that there will be a lower limit of conductive material in the facing below which the sensor will not work.

CLAIMS

1. A friction-facing component incorporating a wear sensor wherein the friction-facing is abradable and contains electrically conductive material, the wear sensor being located in the friction-facing and comprising a pair of terminals, for connection to an electrical detection circuit, and wear probes; the wear probes being:-

respectively connected to each terminal,

embedded within an abradable, electrically insulating compound, and

positioned to be contacted at a given wear point by a counterface against which the friction-facing is supplied;

the insulating compound being capable of trapping electrically conductive material, abraded from the interface between the friction-facing and the counterface, to establish on the sensor an electrically conductive layer which, at the given wear point, will form a conductive link bridging the wear probes.

2. A component as claimed in claim 1, wherein resistor means are connected between the terminals to provide an indication of circuit continuity.

3. A component as claimed in claim 1 and claim 2, wherein one or more additional wear probes of differing height are provided, each positioned to to be contacted at successively lower wear points, one of the original wear probes being connected to one of the terminals, an additional wear probe being connected to the other terminal, resistor means being respectively connected between the wear probes in order of probe height and in series between the terminals.

4. A friction-facing component incorporating a wear sensor substantially as described with reference to or as shown by Figures 1 and 2 or Figures 3 and 4 of the Drawings.

5. A wear sensor for incorporation with a friction-facing component as claimed in any of claims 1 to 4.

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